博士資格　熱力部分 50%

每題 10分

1. Sketch a simplified schematic diagram of a liquid-propellant rocket engine.

2. Show a Pressure-temperature diagram for a substance such as water.

3. A very important relation between the constant-pressure and constant-volume specific heats of an ideal gas is $C_{p0} - C_{v0} = R$. Prove it.

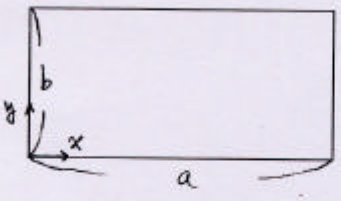
4. (a) What is the Kelvin-Plank statement?
   (b) What is the Clausius statement?

5. Sketch P-v diagrams to show the air-standard diesel cycle and Otto cycle.

Part II Heat Transfer

1. (15%) 請詳述熱傳導（conduction）、熱對流（convection）及熱輻射（radiation）之異同。

2. (10%) 一個二維的矩形板的暫態熱傳導，可以拆成兩個一維的暫態熱傳導題目處理，然後再以分離變數法分別求解，試以下圖爲例說明之。

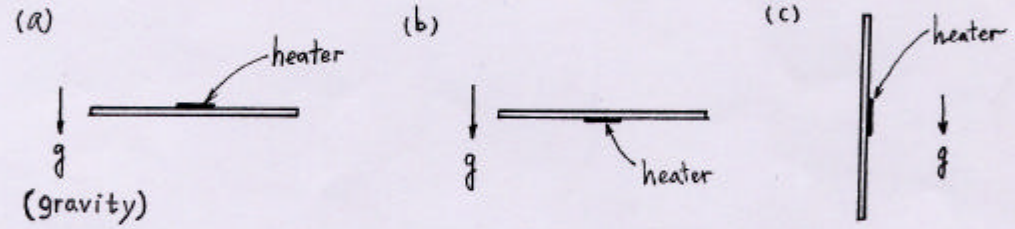


$$\frac{\partial T}{\partial t} = \alpha \nabla^2 T \quad , \quad T(x, y, 0) = T_0$$

$$\frac{\partial T(0, y, t)}{\partial x} = 0 \quad , \quad T(a, y, t) = T_\infty$$

$$\frac{\partial T(x, 0, t)}{\partial y} = 0 \quad , \quad T(x, b, t) = T_\infty$$

3. (15%) 一加熱片（厚度很薄）置於導熱係數很小之板上，如圖所示，此三種不同幾何形狀所引起之熱流現象有何不同？這些現象與哪些無因次參數有關？試說明之。



4. (10%) 何謂熱邊界層（thermal boundary layer）？層流（laminar）的熱邊界層和紊流（turbulent）的熱邊界層特性上有何不同？